

Accelerator Safety Envelope

Title of Facility: Tandem Van de Graaff and Tandem to Booster Transfer Line

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Version of the SAD that the ASE applies to: C-AD SAD, August 2004

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Section 1: Introduction

The ASE Requirements define the conditions, safe boundaries, and the administrative controls necessary to ensure safe TVDG/TTB operations and to reduce the potential risk to the public, workers and environment.

- 1.1 The reference to the method used by the Collider-Accelerator Department for change control of the ASE is the BNL Subject Area on [Accelerator Safety](#).
- 1.2 A variation beyond the boundaries described in Sections 1, 2, 3, and 4 of this ASE shall be treated as a violation of the ASE and shall be a reportable occurrence, as defined by the BNL [SBMS](#) Subject Area on Occurrence Reporting. A violation is defined as not satisfying a Requirement or its specific Authorized Alternative. C-AD Department staff shall make notifications of occurrences according to the requirements in the [C-A Operations Procedure Manual](#).
 - 1.2.1 If a Requirement is not satisfied and it has a specific Authorized Alternative, implement the Authorized Alternate or stop the activity that uses the affected equipment within one hour.
- 1.3 Emergency actions may be taken that depart from these approved ASE Requirements when no actions consistent with the Requirements are immediately apparent and when these actions are needed to protect the public, worker and environmental safety. These actions shall be approved by the person in charge of facility safety, as defined in the operating procedures, when the emergency occurs and shall be reported to C-AD management within 2-hours.

Section 2: BNL Safety Envelope Limits

This section contains the absolute limits that BNL places on its operations to ensure that we meet the regulatory limits established to protect our environment, public and staff/visitors and that those operations are conducted within the assumptions of the TVDG/TTB safety analyses documented in the [C-AD SAD, August 2004](#). BNL Safety Envelope Limits for TVDG/TTB operations are:

- 2.1. Less than 25 mrem in one year to individuals in other BNL Departments or Divisions adjacent to this Collider-Accelerator Department accelerator facility.
- 2.2. Less than 5 mrem in one year to a person located at the site boundary.
- 2.3. Offsite drinking water concentration and on-site potable well water concentration must not result in 4 mrem or greater to an individual in one year.

- 2.4. Less than 1250 mrem in one year to a Collider-Accelerator Department staff member.
- 2.5. In order to protect groundwater, if the annual activity concentration of sodium-22 or tritium in leachate is calculated to exceed 5% of the Drinking Water Standard, then a cap shall be used unless BNL Management is convinced otherwise.¹
- 2.6. All emissions from TVDG/TTB facilities are managed in accordance with the Air Emissions subject area.² If emissions are anticipated to exceed 0.1 mrem per year to the Maximally Exposed Individual, actions will be taken to ensure operations comply with NESHAP requirements including continuous emissions monitoring and permitting.

Section 3: Corresponding TVDG/TTB Safety Envelope Parameters

This section identifies the measurable limitations on critical operating parameters that, in conjunction with the specifically identified hazard control considerations established by the facility design and construction, ensure that TVDG/TTB operations will not exceed the corresponding Safety Envelope Limits discussed in Section 2. These parameters are derived from the safety analyses described in the [C-AD SAD, August 2004](#). TVDG/TTB safety envelope parameters are:

TVDG/TTB Beam Limits

- 3.1. The limit on the beam extracted from the TVDG or injected into the TTB shall be such that exposure to individuals in uncontrolled areas is less than 25 mrem in one year.
- 3.2. Beam limits for specific ions shall be proscribed in terms of beam energy and intensity before operations with the specific ion. These limits shall be set in writing by the C-A Department Radiation Safety Committee in order to meet the requirement in 3.1.

Control of Beam Loss

- 3.3. Loss monitoring results and radiation survey results shall be used in order to maintain beam loss “As Low as Reasonably Achievable” as defined in the [BNL Radiological Manual](#).
- 3.4. Beam loss induced radiation within uncontrolled areas is to be less than 0.5 mrem in an hour and for repeated losses less than 25 mrem in a year.

¹ BNL SBMS Accelerator Safety Subject Area, [Design Practice for Known Beam Loss Locations](#).

² BNL SBMS Subject Area, [Radioactive Airborne Emissions](#).

3.5. Beam loss induced radiation in a Controlled Area is to be less than 5 mrem in an hour and for repeated losses less than 100 mrem in a year.

Classification of Radiological Areas

3.6 Radiological area classifications during operations shall be in accord with requirements in the [BNL Radiation Control Manual](#).

Access Controls

3.7 The Access Controls System shall be functional during operations with beam.

3.8 During operations with beam, area radiation monitors that are interfaced with the Access Controls System shall be within their calibration date.

3.9 During operations with beam, the locations of area radiation monitors interfaced with the Access Control System are to be configuration controlled.

Fire Protection

3.10 During periods of beam operation, the installed fire detection and suppression systems shall be operable.

Authorized Alternative: Within 2 hours of discovery, the Department Chair or designee may allow partial or full inoperability of any fire detection and/or suppression system for up to 80 hours with beam operations if the benefit of continuing beam operations is judged to outweigh the potential risk of fire damage. Operating procedures shall specify the compensatory actions to be taken during inoperability.

3.10.1 In occupied areas, TVDG/TTB equipment may be energized if the smoke detection system for the energized area can transmit an alarm to summon the BNL Fire/Rescue Group.

Authorized Alternative: The Operations Coordinator, ESH Coordinator or designee may allow partial or full inoperability of any fire detection system, suppression system or manual alarm station in occupied areas as long as a Fire Watch is posted who can verbally communicate with the BNL Fire/Rescue Group by radio or phone.

Handling and Alerting System for Insulating Gas

3.11 TVDG accelerator tanks - The absolute maximum allowable working pressure for these vessels shall be 300 psig, as per ASME Code Stamp on the vessel.

3.12 The maximum working pressure for the insulating-gas storage-tanks shall be 575 psig.

3.13 The minimum allowable ambient temperature for the insulating-gas storage-tanks location shall be 32 °F.

3.14 The maximum working pressures for these vessels shall be as follows:

3.14.1 Heat Exchangers: 250 psig @ 300 °F

3.14.2 Dryer Towers: 250 psig @ 450 °F, 450 psig @ 250 °F

3.14.3 Filter Towers: 250 psig @ 100 °F

3.15 Installed oxygen monitors that are used to alert against displacement of oxygen by insulating gas leaking into occupied areas shall alarm for oxygen levels below 19.5%.

Authorized Alternative: The Tandem Supervisor or ESH Coordinator may allow personnel oxygen monitors to be used for up to 80 hours while the installed monitors are out of service.

Column Truss Structure

3.16 For MP6, the maximum additional column load that may be added to the original configuration shall be 5000 pounds concentrated at the high voltage terminal.

3.17 For MP7, the maximum additional column load that may be added to the original configuration shall be 3000 pounds concentrated at the high voltage terminal.

Section 4: Engineered Safety Systems Requiring Calibration, Testing, Maintenance, and Inspection

The systems and requirements for calibration, testing, maintenance, accuracy or inspections necessary to ensure the integrity of the TVDG/TTB safety envelope parameters during operations are given in this section:

4.1. The Access Control System shall be functionally tested in accordance with requirements in the [BNL Radiation Control Manual](#).

4.2. Accelerator building ventilation exhaust fans shall undergo annual testing (not to exceed 15 months).

- 4.3. TVDG/TTB fire protection shall undergo annual testing (not to exceed 15 months).
- 4.4. Area radiation monitors shall undergo annual testing (not to exceed 15 months).
- 4.5. Radiological barriers shall undergo annual visual inspection (not to exceed 15 months).
- 4.6. The insulating gas handling system shall undergo annual inspection and testing (not to exceed 15 months).
- 4.7. The installed oxygen monitoring system shall undergo annual inspection and testing (not to exceed 15 months).

Section 5: Administrative Controls

Administrative controls necessary to ensure the integrity of the TVDG/TTB safety envelope parameters during operations are:

5.1. Minimum Main Control Room Staffing

5.1.1. C-A Main Control Room: one Operations Coordinator and one Operator shall be on duty when TTB beam is injecting into Booster. During normal operations, one of the two must remain in the Main Control Room at all times.

Authorized Alternative: If one operator is incapacitated, the remaining operator may continue operations as long as manning requirements are restored within two hours.

5.1.2. TVDG Control Room: two qualified individuals are required for operation of the MP6 and/or MP7 Tandem accelerators. The operator-in-charge must be fully qualified and must be on-duty at the TVDG facility. The second operator is a person who is judged by the Pre-Injector Group Leader and TVDG Operations Supervisor, or in their absence the TVDG Operations Shift Supervisor, to have sufficient knowledge to assist the operator-in charge. The second operator must be on-duty at the C-A Complex and must have radio communication with the operator-in-charge on-duty at the TVDG.

Authorized Alternative: If the second operator is incapacitated, the operator-in-charge may continue Tandem operations as long as manning requirements are restored within two hours.

5.2. Experiment Area Staffing

- 5.2.1. The minimum experimental area staffing shall be a qualified TVDG operator for TVDG experimental operations with beam.
- 5.3. On-shift Operations staff shall be trained and qualified on their safety, operational and emergency responsibilities. Records of training and qualification shall be maintained on the Brookhaven Training Management System ([BTMS](#)).
- 5.4. Work planning and control systems shall comply with the requirements in the [C-A Operations Procedure Manual](#).
- 5.5. Environmental management shall comply with the requirements in the [C-A Operations Procedure Manual](#).
- 5.6. Experiment modification and review shall comply with the requirements in the [C-A Operations Procedure Manual](#).
 - 5.6.1. Each experiment in the TVDG Target Rooms shall be reviewed before running with beam.
- 5.7. Only qualified TVDG facility operators are authorized to operate the Tandem insulating-gas handling system and they shall comply with the requirements in the [C-A Operations Procedure Manual](#).
- 5.8. Modifications of the Tandem insulating-gas handling-system that are known to increase the oxygen deficiency hazard shall be reviewed by the Tandem Safety Committee and the approved by the C-A Accelerator Systems Safety Review Committee.
- 5.9. Modifications involving addition or removal of equipment from the column truss structures of the Tandem accelerators shall be reviewed by the C-A Department Chief Mechanical Engineer, or his designee.
- 5.10. Industrial hazards shall be controlled in accordance with the applicable portions of the BNL SBMS Subject Area.